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FIBROUS ACTIVATED CARBON CHARCOAL FILTER

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Abstract

Objective

To provide a fibrous activated carbon charcoal filter which can be suitably used without deterioration of the performance of the fibrous activated carbon, and eliminating pressure loss, and

shrinkage deformation of the filter material is minimized even when conducting regeneration under steam.

Means to solve the problems

A filter material A is constructed by arranging pitch group fibrous activated carbon nonwoven fabrics 2a, 2b with permeability on both sides of net 1 having mesh of 80% or more open number, and a portion of the fibers of both pitch group fibrous activated carbon nonwoven fabrics 2a, 2b are entangled with each other via the mesh of the net 1. A fibrous activated carbon charcoal filter is constructed in such a manner that the cylindrical projection 13a having a flat bottom surface at the top edge of the lower projection member 13, and a tubular cylindrical projection 14a of the upper projection member 14 are set apart at a specified gap, a wire netting 15 is connected by extending over both projections 13a, 14a and the side of the wire netting 15 are covered.

Claim

1. A fibrous activated carbon charcoal filter characterized in that a filter material is formed by arranging fibrous activated carbon on respective sides of a net with mesh of 80% or more open [area] for providing gas permeability, and at least a portion of the fibers on one side of said fibrous activated carbon on both sides is entangled with the fibrous activated carbon of the other side through the mesh of said net; a core material is connected in such a way that ventilation is possible by extending it over two projections such that a specified gap is

set between the lower projection member possessing a cylindrical projection with a flat bottom surface on its upper side and the upper projection member possessing a tubular cylindrical projection, and said filter material is rolled out so that the sides of both projections and the sides of said core material are covered in a cylindrical shape.

2. A fibrous activated carbon charcoal filter according to Claim 1, wherein the core material is cylindrical wire netting.

3. A fibrous activated carbon charcoal filter according to Claims 1 and 2, wherein the respective top and bottom edges of the filter material are tied to the sides of both projections by a fastening material.

Detailed explanation of the invention

[0001]

Industrial application field

This invention pertains to a fibrous activated carbon charcoal filter using a filter material made of fibrous activated carbon.

[0002]

Prior art

In order to obtain processed filtration items (hereinafter called filter material) as the filter material made of fibrous activated carbon, conventionally, various synthetic fibers and

natural fibers are processed by a garnet carding machine and needle punch machine, and various filters having the necessary tensile strength are produced.

[0003]

However, for example, for the case of fibrous activated carbon, the ductility of the raw material fiber is less than 5%, and ductility of the raw material fiber in the fibrous activated carbon is small. Although the filter is processed using a method identical to that in the aforementioned conventional method, the manufactured filter lacks tensile strength, and practical use in secondary processing is difficult. Therefore, conventionally, a fiber material mixed with fibers having 5-15% ductility as reinforcement is manufactured.

[0004]

Problems to be solved by the invention

However, for the purpose of providing the prescribed tensile strength, it is necessary to combine 20% or more reinforcement fibers of the total weight to the resultant filter material. Therefore, the weight of fibrous activated carbon content is less than 80%. The weight of fibrous activated carbon content is reduced by this reinforcement, and the ratio of fibrous activated carbon occupying the peripheral surface is decreased. These lead to the problem of deterioration of the original functions of the fibrous activated carbon.

[0005]

Also, a combined activated carbon fiber structure of an organic fiber layer and an activated carbon fiber layer comprising fibrous activated carbon [combined] by needle punching, is disclosed in Japanese Kokai Utility Model No. Sho 54[1979]-139782 as a solution to the aforementioned problem. However, since it is reinforced by an organic fiber layer, an organic fiber layer of a specified thickness is required. When aerating these activated carbon fiber structures, pressure loss due to the organic fiber layer itself provided therein for reinforcement is great, and when it is used as a filter, it has the drawback of insufficient use of absorption power of the fibrous activated carbon.

[0006]

Taking the circumstances into account, the objective of this invention in Claim 1 is to provide a fibrous activated carbon filter that can be preferably used without reducing pressure loss and the functions of fibrous activated carbon, and shrinkage deformation of the filter material is minimized even when conducting regeneration in a steam atmosphere. Also, the objective of this invention in Claim 2 is to improve the shape retention property of the filter material, and the objective of this invention in Claim 3 is the capability of preventing shifting off of the filter material when performing regeneration in a steam atmosphere.

[0007]

Means to solve the problem

In order to attain the objectives, the fibrous activated carbon charcoal filter of this invention regarding Claim 1 is constructed in the manner where a filter material is formed by arranging fibrous activated carbon on respective sides of a net with mesh of 80% or more open [area] for providing gas permeability, and at least a portion of the fibers on one side of said fibrous activated carbon is entangled with the fibrous activated carbon of the other side through the mesh of said net; a core material is connected in such a way that ventilation is possible by extending over both projections such that a specified gap is set between the lower projection member possessing a cylindrical projection with a flat bottom surface on its upper side and the upper projection member possessing a tubular cylindrical projection, and said filter material is rolled out so that the sides of both projections and the sides of said core material are covered in a cylindrical shape.

[0008]

As the net used in this invention, netted moldings made of plastics such as polyester, acrylic, polypropylene, netted moldings made of metals such as wire netting, netted moldings made of carbon fiber, and netted moldings made of glass fiber can be used. Netted moldings made of plastics have the advantage of preventing corrosion damage by selective use of the construction material suitable for the atmosphere in which the resultant

filter material will be used. On the other hand, netted moldings made of metals have the advantage of durability under high temperature and applications requiring hardness. Also, netted moldings made of carbon fibers have advantages such as high strength, heat resistance, chemical resistance, and the occurrence of shrinkage deformation can be eliminated even in a steam atmosphere.

[0009]

As the fibrous activated carbon, various fibrous activated carbons such as the pitch group or polyacrylonitrile (PAN) group, and cellulose group can be used.

[0010]

For the fibrous activated carbon filter of this invention related in Claim 2, in order to attain the aforementioned objective, the core material in the fibrous activated carbon filter of this invention related to Claim 1 is constructed of wire netting.

[0011]

For the fibrous activated carbon filter of this invention related in Claim 3, in order to attain the aforementioned objective, the top and bottom edges of the filter material are tied to the sides of both projections by a wire.

[0012]

Function

According to the configuration of the invention in Claim 1, the net is held between the fibrous activated carbon from both sides, a portion of fibers of one side of fibrous activated carbon or a portion of fibers of both sides of fibrous activated carbon is entangled with the fibers of the other side by being moved to the other side via the mesh by a needle punch machine, and the filter material is constructed by reinforcement and maintaining the fibrous activated carbon via the net.

[0013]

The filter material is rolled out on the cylindrical wires extending over the tubular projection of the upper projection member and a projection part with a bottom [on its upper surface] of the lower projection member. A filter is constructed by forming an air passage extending over the filter material, wire, cylindrical space within the wire, and the tubular projection. Thus, organic solvent gas and odors contained in air [and] in exhaust gas from a paint plant can be absorbed. Also, the absorbed substance can be desorbed by superheated steam.

[0014]

According to the configuration of the invention in Claim 2, the cylindrical shape can be retained by adhering the filter

material to the sides of the cylindrical wire netting and two projections.

[0015]

According to the configuration of the invention disclosed in Claim 3, the top and bottom edges of the filter material are maintained by a fastening material such as a wire or a thin metal band. Shifting can be prevented even when the weight of the filter material is increased by absorption of superheated steam.

[0016]

Embodiments of the invention

Embodiments of the invention are described in detail by referring to diagrams in the following. First, the filter material used in the fibrous activated carbon filter of this invention [will be explained].

[0017]

Application Example 1: Filter material

Figure 1 is an expanded perspective view of a portion of the filter material. The filter material A is made of pitch group fibrous activated carbon nonwoven fabrics 2a, 2b with specific surface area of 2000 m^2/g and metsuke of 150 g/m^2 (300 g/m^2 for both sides) provided on both sides of a net 1 made of polypropylene (Conwed net made by Japan Sekiyuu Kagaku K.K.,

model number: OV3018, sample size: 50 mm x 100 mm, nominal tensile strength measured according to JIS L 1096 in the longitudinal direction is 17 kg and in the cross direction is 14 kg), and a portion of fibers of one side of pitch group fibrous activated carbon nonwoven fabric 2a is entangled with the other side of pitch group fibrous activated carbon nonwoven fabric 2b via meshes 3... of net 1.

[0018]

As the aforementioned pitch group fibrous activated carbon nonwoven fabric, those with specific surface area of 500-2500 m^2/g can be used. Various fibrous activated carbons such as polyacrylonitrile (PAN) group and cellulose group are suitable to use in addition to the pitch group. The respective sides are formed by fibrous activated carbon with metsuke per unit area of 50-200 g/m^2.

[0019]

As the aforementioned net 1, one with thickness of approximately 0.2 mm, and total open area of mesh 3 per unit area (hereinafter, called open number) above 80% (more than 95% is preferred) is used. The open number limit should be set by taking into account the strength required according to the usage.

[0020]

A manufacturing method of the aforementioned filter material A is described with reference to the side view in Figure 2 in the following.

[0021]

(A) First, as shown in Figure 2 (a), the end of the net 1 is placed on a horizontal conveyer 4, and fibrous activated carbon 7 is supplied to and spread on the net 1 by a rake-like rotary body 6 configured with a garnet carding machine 5 installed above [the above conveyor] while transporting the net 1.

[0022]

(B) While loading fibrous activated carbon 7 on the net 1, it is transported to the needle punch machine 9 from the horizontal conveyer 4 via a lifting conveyer 8, pierced with needles 10..., and a portion of fibers of the fibrous activated carbon nonwoven fabric 2a is allowed to protrude via the mesh 3... of the net 1. Then, it is taken up by take-up roll 11, one side of filter material B possessing fibrous activated carbon nonwoven fabric 2a on one side of the net 1 is obtained, and the first part of the process is completed.

[0023]

(C) As shown in Figure 2 (b), using the same device as the one mentioned above, one side [sic] of filter material B obtained

in the first part of the process is held on a feed roll 12 installed at the point of the lifting conveyer 8 where it begins to carry [the net]. The fibrous activated carbon 7... is supplied and spread from the top by a garnet carding machine 5 while the horizontal conveyer 4 is driven.

[0024]

(D) The fibrous activated carbon 7... is carried upward from the horizontal conveyer 4 by being delivered to the lifting conveyer 8 while one side of rolled up filter material B is continuously supplied from the feed roll 12 onto the fibrous activated carbon 7... on the lifting conveyer 8 such that the net side 1 [of filter material B] is on the lower side.

[0025]

(E) It is carried and delivered to the needle punch machine 9 from the lifting conveyer 8. Similarly to the aforementioned case, again, a portion of the fibers of the fibrous activated carbon nonwoven fabric 2a is entangled with the fibers of the lower fibrous activated carbon nonwoven fabric 2b of the net 1 by projecting through the mesh 3... of the net 1. Both fibrous activated carbon nonwoven fabrics 2a, 2b are taken up by the take-up roll 11 and become an integrated body. A filter material A possessing the fibrous activated carbon nonwoven fabrics 2a, 2b on both sides of the net 1 is obtained. The last part of the process is completed. Thus, the manufacturing of a the fibrous activated carbon filter material reinforced by a net is finished.

[0026]

As stated above, the first part of the process and the last part of the process are performed using the same device. However, it is acceptable to install one of the devices on the horizontal conveyer 4, and supply one side of the filter material B obtained in this manner to another device, and continuously manufacture the filter material A.

[0027]

Also, for example, it is acceptable for the feed roll 12 to be installed on the horizontal conveyer 4 at the point at which it begins to carry [the net]. One side of the filter material B is supplied to the horizontal conveyer 4 with the net 1 on top. The fibrous activated carbon 7... is supplied spread and on top of the net 1. Needle punching is performed on a fibrous activated carbon nonwoven fabric 2b different from the fibrous activated carbon nonwoven fabric 2a that was needle punched by needle punch machine 9 earlier. Portions of fibers for each fibrous activated carbon nonwoven fabric 2a and 2b are entangled with each other.

[0028]

Comparative Example 1: Filter material

A filter material is produced by using 100% pitch group fibrous activated carbon with metsuke 300 g/m^2.

[0029]

Comparative Example 2: Filter material

A filter material is produced by using the one with metsuke 300 g/m^2 combined with 20% polyester fibers indicated previously in the conventional example.

[0030]

The filter materials of the aforementioned Application Example 1 (③ in the table), Comparative Example 1 (① in the table), and Comparative Example 2 (② in the table) are used in a comparison experiment on the tensile strength and toluene absorption. The results shown in Table I are obtained.

[0031]

Tensile strength is measured on a sample size of 50 mm x 100 mm according to JIS L 1096. Toluene absorption (g/g) is measured based on JIS K 1474 using a solvent steam absorption performance testing device.

[0032]

[Table I]

	①	②	③
1 引張強度 (kg)	—	2	15
2 トルエン吸着能 (g/g)	1.1	0.78	1.1

Key: 1 Tensile strength
2 Toluene absorption power

[0033]

It is clear from the above results that the filter material A of Application Example 1 of this invention has superior tensile strength as well as toluene absorption compared to the filter materials of Comparative Examples 1 and 2. In addition, toluene absorption identical to that of the fibrous activated carbon without the filtration process [sic] can be obtained, and its tensile strength can be improved without deteriorating the solvent absorption performance, which is one of the original functions.

[0034]

Application Example 2: Filter material

A molding netted made of glass fibers with thickness of 0.2 mm and porosity of 95% (Kurenet [transliteration] made by Kurashiki Bouseki K.K., model number: G3380, sample size: 100 mm x 100 mm, nominal tensile strength measured according to JIS L 1096 is 75 kg in the longitudinal direction and 72 kg in the cross direction) is used to replace the polypropylene net of the aforementioned Application Example 1.

[0035]

The filters of the aforementioned Application Examples 1 and 2 are cut into sample sizes of 100 m x 100 mm and placed in a dryer. The change in size is measured after they are kept under a high-temperature atmosphere such as a temperature of 120°C for 1 h. Shrinkage deformation is not found in the filter material of Application Example 2. However, shrinkage of 7% in the longitudinal direction and 3% at the cross direction is observed in the filter material of Application Example 1.

[0036]

It is clear from the results that by forming the net with a molding netted made of glass fibers, a reinforced fibrous activated carbon filter material with excellent heat resistance can be obtained.

[0037]

Application Example 3: Filter material

A filter material A is produced by conducting needle punching by arranging a pitch group fibrous activated carbon nonwoven fabric 2a with specific surface area of 700 m^2/g on one side of the net 1, then conducting needle punching by arranging the pitch group fibrous activated carbon nonwoven fabric 2b with specific surface area of 1500 m^2/g on the other side of the net 1 so that its weight is only 2/3 of the former.

[0038]

The entire specific surface of the filter material of Application Example 3, the entire specific surface area is approximately 1000 m^2/g. The radius for the small holes on one side of the pitch group fibrous activated carbon nonwoven fabric 2a is small and the absorption power can be increased. Low-concentration solvent gas can also be sufficiently absorbed. On the other hand, the radius for the small holes on one side of the pitch group fibrous activated carbon nonwoven fabric 2b is large, and the absorption amount can be increased. High-concentration solvent gas can be absorbed in a large quantity. Regardless of the concentration of the solvent gas to be absorbed, [the filter] has the advantage of absorbing the solvent gas perfectly.

[0039]

Dimethyl sulfide, which is the odor component of natural gas (city gas), was allowed to flow at the concentration of 2 ppm by using the filter material of the Application Example 3, and the breakthrough absorption amount was measured. The result was 9.1 mg/g. For example, in comparison with the breakthrough absorption amount for the pitch group fibrous activated carbon nonwoven fabric with small radius of fine holes and specific surface area of 700 m^2/g, which was 7.5 mg/g, the breakthrough absorption amount can be increased regardless of the large specific surface area. It is clear that satisfactory absorption performance can be obtained as a whole.

[0040]

In Application Example 3, it is preferred that the specific surface area of one side of the pitch group fibrous activated carbon nonwoven fabric 2a of the net 1 is different from the other side of the pitch group fibrous activated carbon nonwoven fabric 2b according to the nature and state of the solvent gas to be absorbed. Also, it is desirable to adjust the weight ratio for both according to the resultant specific surface area as a whole.

[0041]

As the net 1 used in Application Example 3, the netted moldings made of plastics metals, carbon fibers, and glass fibers can be used.

[0042]

A fibrous activated carbon filter of this invention constructed in a manner that can prevent performance deterioration caused by shrinkage deformation under the high temperatures in the case of the configuration of a solvent absorption device using the filter material A of Application Example 1 is explained in the following.

[0043]

Figure 3 is a front view of the entire cylindrical member constructed with the fibrous activated carbon filter. Figure 4 is a front view showing the entire fibrous activated carbon filter. Figure 5 is a longitudinal cross section of the entire fibrous activated carbon filter.

[0044]

A cylindrical wire netting 15 is connected by welding over the bottom part of the projection 14a of the upper projection member 14 formed by steel plate or stainless steel plate and the upper part of the projection 13a of the lower projection member 13 formed by steel plate or stainless steel plate as the core material. The aforementioned filter material A is rolled up so as to cover the entire sides of both projections 13a, 14a and the wire netting 15. Although the net 1 is shrunken and deformed by superheated steam provided for solvent recovery, or the top and bottom width of the filter material A is shortened and a gap is produced between the filter material A and the respective flat

plate of the lower projection member 13 and upper projection member 14, poor absorption and leakage of solvent from the gap can be prevented by both projections 13a, 14a. As the core material used, it is not restricted to the aforementioned cylindrical wire netting 15. For example, various configurations such as the connection of rods to both projections 13a, 14a along the circumference leaving a specific gap [between the rods] can be adapted.

[0045]

The top and bottom of the filter material A are fastened to both projections 13a, 14a by a wire 16. This configuration can effectively prevent poor absorption and leakage of solvent from a gap and formation of a gap between the top end of the filter material A and the upper projection member 14 as the filter material A shifts because of increased weight, when the filter material A absorbs superheated steam supplied for solvent recovery.

[0046]

The projection 13a of the lower projection member 13 is formed so that the upper side is a flat bottom surface in the opposite direction of the cylindrical body with a bottom. With this structure, accumulation of water drops can be prevented during treatment with superheated steam.

[0047]

On the other hand, the projection 14a of the upper projection member 14 is constructed as a tubular cylindrical body. The treatment gas and steam are allowed to flow through the filter material A and the space within the wire netting 15 and the projection 14a of the upper projection member 14.

[0048]

A fibrous activated carbon filter with the aforementioned configuration was immersed in a water trough. An air pump was connected to the upper projection member 14 via a pipeline. Air was supplied within the fibrous activated carbon filter, air bubbles were produced all over filter material A, and leakage from the respective top and bottom edges of the filter material A was not observed.

[0049]

Also, shifting off of the filter material A did not occur after removal from the water and standing for 24 h. The aforementioned fibrous activated carbon filter was built in a solvent absorption device. A gas containing flon gas with concentration of 2000 ppm was supplied by a blower at 3 m^3/min. Flon gas was not detected at the exit side, showing that it was completely absorbed by the filter material A.

[0050]

Effectiveness of the invention

It is clear from the above explanation, that with the invention of Claim 1, since the fibrous activated carbon is reinforced and maintained by utilizing a mesh, the fibrous activated carbon can be entirely exposed on the outer surface of the resultant filter material. The original functions of the fibrous activated carbon can be displayed 100% without being effected by the reinforced configuration.

[0051]

In addition, since a mesh with 80% or more open number is provided to the net, the pressure loss accompanying permeability can be reduced when used in a solvent absorption device, and the absorption power of the fibrous activated carbon can be fully displayed.

[0052]

Since the fibrous activated carbon possesses fine holes on the surface of the carbon fibers, and its strength is very weak, it is easily damaged, such as breakage if it is not handled with care. With this invention, since it is reinforced by a net by entangling a portion of fibers, its strength is high for the entire resultant filter material, and it is easy to handle, and shrinkage deformation can be prevented. In addition, since the filter material is rolled out so that the sides of both

projections and the side of the core material are covered in a cylindrical shape, even when the top and bottom of the net are shortened due to superheated steam, occurrence of poor absorption can be satisfactorily prevented only by movement of the top and bottom edges of the filter material while in contact with the sides of both projections. Also, when making the net out of glass fibers and building it into a solvent absorption device, or when conducting recovery and regeneration of the solvent by placing it in a superheated steam atmosphere, corrosion damage of the metal net can be avoided. Excellent absorption performance can be displayed over a long period of time, and a fibrous activated carbon filter with excellent durability can be provided.

[0053]

Also, according to the invention in Claim 2, since the filter material is kept in a cylindrical shape by adhering it to two projections and the sides of the cylindrical wire netting, shape retention can be improved, deformation can be controlled, and absorption performance and durability can be further improved.

[0054]

According to the invention in Claim 3, since both edges of the filter material are held by a fastening material to two projections, although the weight of the filter material is increased by absorption of superheated steam, shifting can be prevented, and the long-term absorption performance can be further improved.

Brief description of the figures

Figure 1 is a perspective view of a partial development of the filter material.

Figure 2 is a side view of a manufacturing device supplied for description of a manufacturing method of the filter material.

Figure 3 is a front view of an entire cylindrical member for constructing the fibrous activated carbon filter.

Figure 4 is a front view showing the entire fibrous activated carbon filter.

Figure 5 is a longitudinal cross section of the entire fibrous activated carbon filter.

Explanation of reference symbols

1...net
2a, 2b...carbon fiber nonwoven fabric
13...lower projection member
13a...cylindrical member with a bottom
14...upper projection member
14a...tubular cylindrical member
15...wire netting as the core material
16...wire as the fastening member
A...filter material

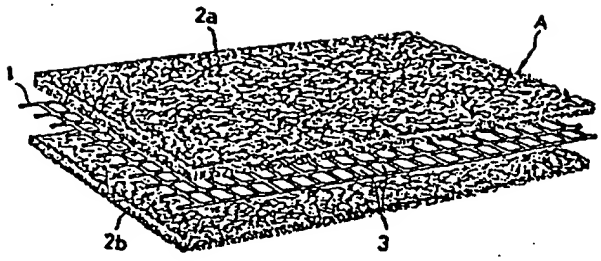

Figure 1

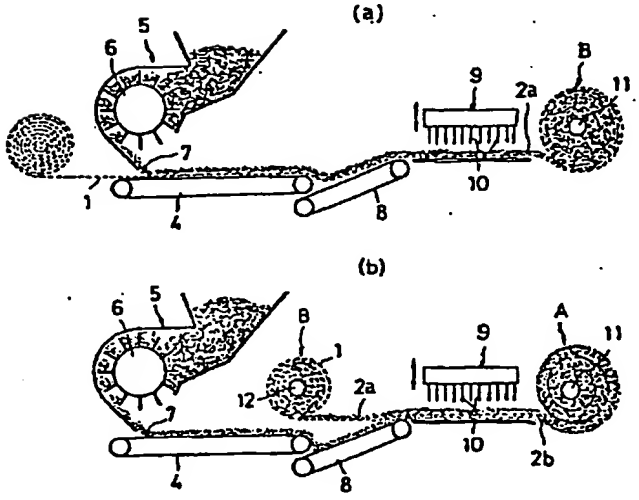

Figure 2

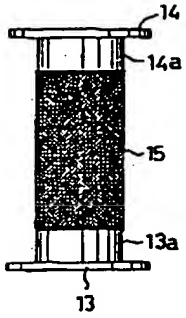

Figure 3

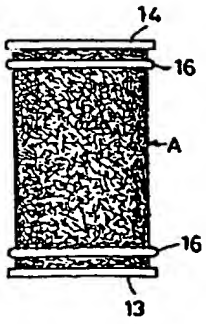

Figure 4

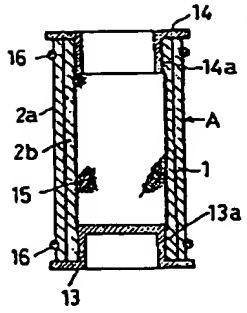

Figure 5